PESTICIDE SURFACE WATER AND SEDIMENT QUALITY REPORT

DECEMBER 1998 SAMPLING EVENT

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Pesticide Monitoring Project Report
December 1998 Sampling Event

Executive Summary

As part of the District's quarterly ambient monitoring program, unfiltered water and sediment samples from 36 sites were collected from December 7 to December 15, 1998 and analyzed for over sixty pesticides and/or products of their degradation. The herbicides ametryn, atrazine, bromacil, diuron, hexazinone, metribuzin, norflurazon, and simazine, along with the insecticides alpha- and beta-endosulfan, endosulfan sulfate, ethion, and ethoprop, were detected in one or more of these surface water samples. The ethion concentrations of 0.027 μg/L at S99, approach the 48 hour EC_{50} of 0.06 μg/L, reported for *Daphnia magna*, a sensitive indicator species for aquatic macroinvertebrate. However, the concentrations exceed the chronic toxicity level (0.003 μg/L) for *Daphnia magna* calculated according to promulgated procedure (FAC 62-302.200). At this level, long term exposure can cause impacts to the macroinvertebrate populations. The herbicide ametryn as well as the insecticides/degradates beta-endosulfan, DDD, DDE, and DDT were found in the sediment at several locations. Some of the detected sediment concentrations of DDD, DDE, and DDT are usually associated with the potential for impacting wildlife when compared to coastal sediment quality assessment guidelines. There are no corresponding freshwater sediment quality assessment guidelines, however. The compounds and concentrations found are typical of those expected from intensive agricultural activity.

Background and Methods

The District's pesticide monitoring network includes stations designated in the Everglades National Park Memorandum of Agreement, the Miccosukee Tribe Memorandum of Agreement, the Lake Okeechobee Operating Permit, and the non-Everglades Construction Project (non-ECP) permit. Surface waters are sampled quarterly and sediments semiannually.

Sixty-four pesticides and degradation products were analyzed for in samples from all of the 36 sites (Figure 1). The analytes, their respective minimum detection limits (MDL), and practical quantitation limits (PQL) are listed in Table 1. Each pesticide's description and possible uses and sites of application are taken from Hartley and Kidd (1987). The Florida Ground Water Guidance Concentrations (FDEP, 1994a) are listed to provide an indication at what level these pesticide residues could possibly impact human health, based on drinking water consumption or other routes of exposure (e.g., inhalation, ingestion of food residues, dermal uptake). Primary ground water standards are enforceable ground water standards, not screening tools or guidance levels. To evaluate the potential impacts on aquatic life, due to the pulsed nature of exposure, the maximum observed concentration is compared to the Criterion Maximum Concentration published by the USEPA under Section 304 (a) of the Clean Water Act, if available, or the lowest EC_{50} or LC_{50} reported in the summarized literature. Sediment concentrations are compared to coastal sediment quality assessment guidelines (FDEP, 1994b), as there are no corresponding freshwater sediment quality assessment guidelines. This summary covers surface water and sediment

samples collected between December 7 and December 15, 1998.

Findings and Recommendations

At least one pesticide was detected in the surface water and sediment at 32 and 7, respectively, of the 36 sites. The concentrations of the pesticides detected at each of the sites are summarized for the surface water and sediment in Tables 2 and 3, respectively. All these compounds have previously been detected in this monitoring program.

The above findings must be considered with the caveat that pesticide concentrations in surface water may vary significantly with relation to the timing and magnitude of pesticide application, rainfall events, pumping and other factors, and that this was only one sampling event. The possible long term or chronic toxicity impacts are also reported based on the single sampling event and do not take into account previous monitoring data.

Usage and Water Quality Impacts

Ametryn: Ametryn is a selective terrestrial herbicide registered for use on sugarcane, bananas, pineapple, citrus, corn, and non-crop areas. Most algal effects occur at concentrations > 10 µg/L (Verschueren, 1983). Environmental fate and toxicity data in Tables 4 and 5 indicate that ametryn (1) is lost from soil relatively easily by leaching, surface adsorption, and in surface solution; (2) is relatively non-toxic to mammals and fish; and (3) does not bioconcentrate significantly. Additional fish toxicity data includes a 96 hour LC_{50} of 14.1 mg/L for goldfish (Hartley and Kidd, 1987). The ametryn surface water concentrations found in this sampling event ranged from 0.010 to 0.16 µg/L and the sediment value was 15 µg/Kg. Using these criteria, these surface water levels should not have an acute, detrimental impact on fish or aquatic invertebrates. No sediment quality assessment guidelines have been developed for ametryn.

Atrazine: Atrazine is a selective systemic herbicide registered for use on pineapple, sugarcane, corn, rangelands, ornamental turf and lawn grasses, and non-crop areas. Environmental fate and toxicity data in Tables 4 and 5 indicate that atrazine (1) is easily lost from soil by leaching and in surface solution, with moderate loss from surface adsorption; (2) is relatively non-toxic to mammals and fish; and (3) does not bioconcentrate significantly. Additional fish toxicity data include a 96 hour LC_{50} of 76 mg/L for carp, 16 mg/L for perch and 4.3 mg/L for guppies (Hartley and Kidd, 1987). Also, in a flow-through bioassay, the maximum acceptable toxicant concentration (MATC) of atrazine was 90 and 210 µg/L for bluegill and fathead minnow (Verschueren, 1983). Atrazine inhibits cell multiplication of the alga, *Microcystis aeruginosa*, at 3 µg/L and most other biological effects occur at higher concentrations (Verschueren, 1983). The atrazine surface water concentrations found in this sampling event ranged from 0.012 to 1.8 µg/L. Using these criteria, these levels should not have an acute, detrimental impact on fish or aquatic invertebrates. Atrazine was not quantified in the sediment.

Bromacil: Bromacil is a terrestrial herbicide registered for use on pineapple, citrus, and non-crop areas. Environmental fate and toxicity data in Tables 4 and 5 indicate that bromacil (1) is easily lost from soil by leaching, with moderate loss from surface adsorption or surface solution; (2) is relatively non-toxic to mammals and fish; and (3)

does not bioconcentrate significantly. Additional fish toxicity data includes a 96 hour LC_{50} of 164 mg/L for carp (Hartley and Kidd, 1987). The highest concentration of bromacil detected in the surface water during this sampling event was 0.25 µg/L. Using these criteria, these levels should not have an acute or chronic detrimental impact on fish. Bromacil was not quantified in the sediment.

DDE, DDD: DDE is an abbreviation of **d**ichloro**d**iphenyldichloro**e**thylene [2,2-bis(4-chlorophenyl)-1,1-dichloroethene]. DDE is an environmental dehydrochlorination product of DDT (**d**ichloro**d**iphenyl**t**richloroethane), a popular insecticide for which the USEPA cancelled all uses in 1973. The large volume of DDT used, the persistence of DDT, DDE and another metabolite, DDD (**d**ichloro**d**iphenyl**d**ichloroethane), and the high K_{oc} of these compounds accounts for the frequent detections in sediments. The large hydrophobicity of these compounds also results in a significant bioaccumulation factor. In sufficient quantities, these residues have reproductive effects in wildlife and carcinogenic effects in many mammals. Sediment quality assessment guidelines have been developed for several metals and organic compounds in coastal sediments (FDEP, 1994b). The threshold effects level (TEL) is 2.1 µg/Kg and the probable effects level (PEL) is 374 µg/Kg for DDE in coastal sediments. The DDE concentrations detected (2.3 to 61 µg/Kg) are between the TEL and PEL. The levels between the TEL and PEL have the possibility for impacting wildlife as they have exceeded the threshold level. The DDD concentrations detected are 1.8 and 5.4 µg/Kg. These values, which are between the TEL (1.2 µg/Kg) and PEL (7.8 µg/Kg), also have the possibility for impacting wildlife. The only DDT concentration detected (2.1 µg/Kg) falls between the TEL (1.2 µg/Kg) and PEL (4.8 µg/Kg). This level has the possibility for impacting wildlife. As expected, there were no detections of these compounds in the surface water.

Diuron: Diuron is a selective, systemic terrestrial herbicide registered for use on sugarcane, bananas, and citrus. Environmental fate and toxicity data in Tables 4 and 5 indicate that diuron (1) is easily lost from soil in surface solution, with moderate loss from leaching or surface adsorption; (2) is relatively non-toxic to mammals and fish; and (3) does not bioconcentrate significantly. Additional fish toxicity data includes a 96 hour LC_{50} of 25 mg/L for guppies (Hartley and Kidd, 1987). Crustaceans are affected at lower concentrations with a 48 hour LC_{50} of 1.4 mg/L for water fleas and a 96 hour LC_{50} of 0.7 mg/L for water shrimp (Verschueren, 1983). Most algal effects occur at concentrations > 10 µg/L (Verschueren, 1983). The highest concentration of diuron found during this sampling event was 1.2 µg/L. Using these criteria, this level should not have an acute, harmful impact on fish or algae. Diuron was not quantified in the sediment.

Endosulfan: Endosulfan is a non-systemic insecticide and acaricide registered for use on many crops, including beans, tomatoes, corn, cabbage, citrus, and ornamental plants. Technical endosulfan is a mixture of the two stereoisomeric forms, the α (alpha) and the β (beta) forms. Endosulfan is highly toxic to mammals, with an acute oral LD_{50} for rats of 70 mg/kg (Hartley and Kidd, 1987). The Soil Conservation Service rates endosulfan with an extra small potential for loss due to leaching, a large potential for loss due to surface adsorption and a moderate potential for loss in surface solution (Table 4). β-endosulfan's water solubility and Henry's constant indicate volatilization may be significant in shallow

waters. A bioconcentration factor of 1,267 indicates a low to moderate degree of accumulation in aquatic organisms (Lyman et al., 1990). The only endosulfan (α plus β) surface water concentration detected (S178) during this sampling event does not exceed the Florida Class III surface water quality standard (Chapter 62-302) of 0.056 µg/L. Since January 1996, 11 sampling events have been performed without an exceedance of the water quality standard (Figure 2).

Endosulfan sulfate: Endosulfan sulfate is an oxidation metabolite of the insecticide endosulfan. The water solubility and Henry's constant indicate that endosulfan sulfate is less volatile than water and concentrations will increase as water evaporates (Table 4)(Lyman et al., 1990). Endosulfan sulfate has a relatively high degree of accumulation in aquatic organisms (Lyman et al., 1990). The surface water concentrations detected in this sampling event range from 0.0029 to 0.066 µg/L. No FDEP surface water standard (FAC 62-302) has been promulgated for endosulfan sulfate. However, the highest concentration exceeds the Florida Class III surface water quality standard of 0.056 µg/L, for the parent compound, endosulfan (Figure 2).

Ethion: Ethion is a non-systemic acaricide and insecticide registered for use on several fruits, citrus, and vegetables. Environmental fate and toxicity data in Tables 4 and 5 indicate that: (1) ethion is strongly sorbed to soil and therefore can accumulate in sediments; (2) ethion is slightly toxic to mammals, relatively toxic to fish and extremely toxic to Daphnia; and (3) ethion bioconcentrates to a limited extent. Several sources of toxicity information have shown both agreement and disagreement of these laboratory tests. The ethion surface water concentration of 0.027 µg/L at S99, approaches the 48 hour EC_{50} of 0.06 µg/L, reported for *Daphnia magna*, a sensitive indicator species for aquatic macroinvertebrate (Figure 3). However, the concentration exceeds the chronic toxicity level (0.003 µg/L) for *Daphnia magna*, calculated according to promulgated procedure (FAC 62-302.200)(Table 5). At this level, long term exposure can cause impacts to the macroinvertebrate populations. Since December 1994, seven out of seventeen sampling events had a detectable level of ethion. With the method detection limit around 0.02 µg/L, any detection will automatically exceed the calculated chronic toxicity (0.003 µg/L). Ethion was not detected in the sediment.

Ethoprop: Ethoprop is a non-systemic soil insecticide/nematicide used on many crops including potatoes, tomatoes, sugarcane and turf. Environmental fate and toxicity data in Tables 4 and 5 indicate that ethoprop (1) has a large potential for loss due to leaching, a medium potential for loss in surface solution, and a small potential for loss due to surface adsorption; (2) is moderately toxic to mammals and relatively non-toxic to fish; and (3) does not bioconcentrate significantly. Aquatic invertebrate LC_{50} toxicity ranges from 13 µg/L to 25.3 µg/L for ethoprop (U.S. Environmental Protection Agency, 1985). The highest surface water concentration of ethoprop found in this sampling event was 0.039 µg/L. This concentration is below a level that would have an acute detrimental impact on fish or aquatic invertebrates. Ethoprop was not quantified in the sediment.

Hexazinone: Hexazinone is a non-selective contact herbicide that inhibits photosynthesis. Registered uses include sugarcane, pineapple, and non-crop areas. Environmental fate and

toxicity data in Tables 4 and 5 indicate that hexazinone (1) is easily lost from soil by leaching, with moderate loss from surface adsorption or surface solution; (2) is relatively non-toxic to mammals and fish; and (3) does not bioconcentrate significantly. Hexazinone is practically non-toxic to freshwater invertebrates with an EC_{50} of 145 mg/l for *Daphnia magna* (U.S. Environmental Protection Agency, 1988). The hexazinone surface water concentrations found in this sampling event ranged from only 0.024 to 0.080 µg/L and should not have an acute impact on fish or aquatic invertebrates.

Metribuzin: Metribuzin is a selective systemic herbicide used on a variety of crops including potatoes, tomatoes, sugarcane, and peas. Environmental fate and toxicity data in Tables 4 and 5 indicate that metribuzin (1) has a large potential for loss due to leaching, a medium potential for loss in surface solution, and a small potential for loss due to surface adsorption; (2) is relatively non-toxic to mammals and fish; and (3) does not bioaccumulate significantly. The only concentration of metribuzin detected was 0.071 µg/L. Using these criteria, this surface water level should not have an acute impact on fish or aquatic invertebrates. Metribuzin was not detected in the sediment.

Norflurazon: Norflurazon is a selective herbicide registered for use on many crops including citrus. Environmental fate and toxicity data in Tables 4 and 5 indicate that norflurazon (1) is easily lost from soil surface solution and a moderate potential for loss due to leaching and surface adsorption; (2) is relatively non-toxic to mammals and fish; and (3) does not bioconcentrate significantly. The LC_{50} for norflurazon is >200 mg/L for catfish and goldfish (Hartley and Kidd, 1987). The norflurazon surface water concentrations ranged from 0.062 to 0.80 µg/L. Even at the highest concentration, this is over two orders of magnitude below the calculated chronic action level. Using these criteria, these levels should not have an acute, detrimental impact on fish or aquatic invertebrates.

Simazine: Simazine is a selective systemic herbicide registered for use on many crops including sugarcane, citrus, corn, and non-crop areas. Environmental fate and toxicity data in Tables 4 and 5 indicate that simazine (1) is easily lost from soil by leaching and has a moderate potential for loss due to surface adsorption and surface solution; (2) is relatively non-toxic to mammals and fish; and (3) does not bioconcentrate significantly. Additional fish toxicity data include a 96 hour LC_{50} of 49 mg/L for guppies (Hartley and Kidd, 1987). Most of the aquatic biological effects occur at concentrations > 500 µg/L (Verschueren, 1983). Aquatic invertebrate LC_{50} toxicity ranges from 3.2 mg/L to 100 mg/L for simazine (U.S. Environmental Protection Agency, 1984). The highest surface water concentration of simazine found in this sampling event was 0.12 µg/L, far below any level of concern for fish or aquatic invertebrates. No simazine was quantified in the sediment.

Quality Assurance Evaluation

Four duplicate samples were collected at sites S12C, S18C, S190, and S4. All the analytes detected in the surface water had precision ≤15% RSD. No analytes were detected in the two field blanks submitted, which were collected at S18C and S4. All samples were shipped and all bottles were received with the exception of the urea herbicide bottle for the field blank performed at C51SR7. No sediment samples are collected at S142, C51SR7,

S6, and CR33.5T. Sediment samples were collected but pesticide analysis was not performed at: S78, S79, S235, S4, S3, S2, G94D, and ACME1DS.

Low concentrations of representative analytes from each pesticide group/method were added to laboratory water as well as to samples submitted. The matrix spike accuracy and precision for atrazine were not assessed due to high content of this parameter in the sample spiked. The only analyte with a very poor recovery from spiked sample (approximately $\ll$70% and $\gg$130%) was 2,4,5-T. One of the two matrix spikes had a low recovery. These evaluations are applicable to selected sediment samples collected during the third and fourth days. Atrazine concentrations could only be estimated at four sites (S177, S332, S176, and S331) due to a calibration check standard exceeding control limits. Comparisons are based on the FDEP Comprehensive Quality Assurance Plan targets for precision and accuracy. Organic quality assurance targets are set according to historically generated data or are adapted from the U.S. Environmental Protection Agency with slight modifications or internal goals, based on FDEP limited data. Parameters with low or high recoveries indicate that the sample matrix interferes with these analyses and interpretation of the respective analytical results should consider this effect.

Glossary

LD_{50}: The dosage which is lethal to 50% of the terrestrial animals tested within a short (acute) exposure period, usually 24 to 96 hours.

LC_{50}: A concentration which is lethal to 50% of the aquatic animals tested within a short (acute) exposure period, usually 24 to 96 hours.

EC_{50}: A concentration necessary for 50% of the aquatic species tested to exhibit a toxic effect short of mortality (e.g., swimming on side or upside down, cessation of swimming) within a short (acute) exposure period, usually 24 to 96 hours.

Koc: The soil/sediment partition or sorption coefficient normalized to the fraction of organic carbon in the soil. This value provides an indication of the chemical's tendency to partition between soil organic carbon and water.

Bioconcentration Factor:
The ratio of the concentration of a contaminant in an aquatic organism to the concentration in water, after a specified period of exposure via water only. The duration of exposure should be sufficient to achieve a near steady-state condition.

Soil or water half-life:
The time required for one-half the concentration of the compound to be lost from the water or soil under the conditions of the test.

MDL: The minimum concentration of an analyte that can be detected with 99% confidence of its presence in the sample matrix.

PQL: The lowest level of quantitation that can be reliably achieved within specified limit

of precision and accuracy during routine laboratory operating conditions. The PQL is further verified by analyzing spike concentrations whose relative standard deviation in 20 fortified water samples is < 15%. In general, the PQL is 2 to 5 times larger than the MDL.

TEL: The threshold effects level represents the upper limit of the range of sediment contaminant concentrations dominated by no effect data entries, or the minimal effects range. Within this range, concentrations of sediment-associated contaminants are not considered to represent significant hazards to aquatic organisms

PEL: The probable effects level was calculated to define the lower limit of the range of contaminant concentrations that are usually or always associated with adverse biological effects or the lower limit of the probable effects range. Within the probable effects range, concentrations of sediment-associated contaminants are considered to represent significant and immediate hazards to aquatic organisms.

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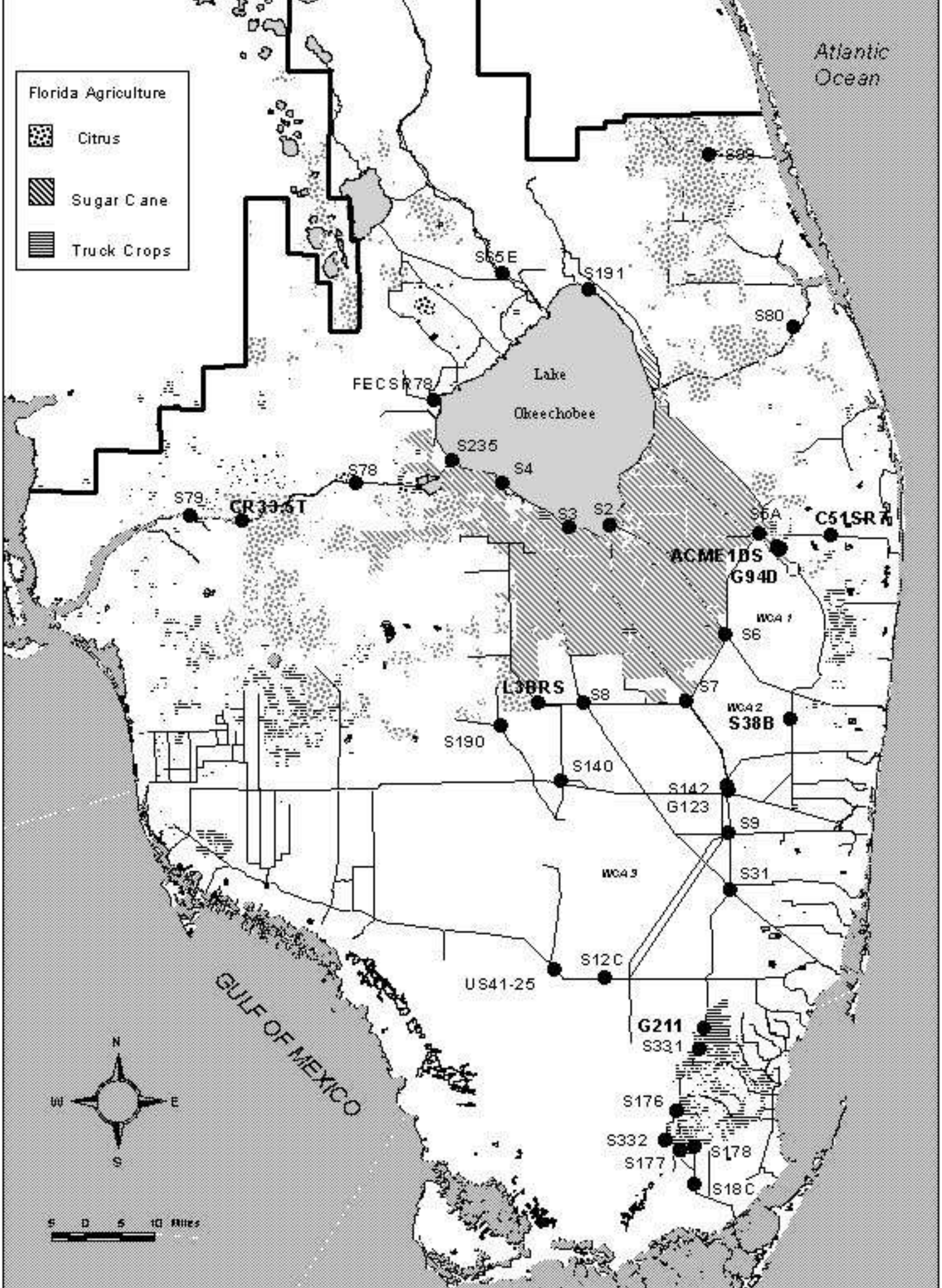
Florida Agriculture
Citrus
Sugar Cane
Truck Crops
Atlantic Ocean
S80
S191
S155E
FECSR78
Lake Okeechobee
S235
S4
S78
S79
CR336T
S3
S2
S6A
C51SR7
ACME1DS
G94D
WCA 1
S6
L38RS
S8
S7
WCA 2
S38B
S190
S140
S142
G123
S9
WCA 3
S31
S12C
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S332
S178
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Table 1. Minimum detection limits (MDL) and practical quantitation limits (PQL) for pesticides determined in December 1998.

Pesticide	Water range of MDL-PQL (µg/L)	Sediment range of MDL-PQL (µg/Kg)	Pesticide	Water range of MDL-PQL (µg/L)	Sediment range of MDL-PQL (µg/Kg)
2,4-D	2 – 4	32 – 1000	endrin	0.0019 - 0.01	1.6 – 93
2,4,5-T	2 – 4	32 – 1000	endrin aldehyde	0.0019 - 0.01	0.80 – 46
2,4,5-TP (silvex)	2 – 4	32 – 1000	ethion	0.019 - 0.1	1.8 – 120
alachlor	0.047 - 0.26	11 – 690	ethoprop	0.019 - 0.1	3.8 – 240
aldrin	0.00094 - 0.0052	0.46 – 24	fenamiphos (nemacur)	0.028 – 0.16	11 – 690
ametryn	0.0094 - 0.052	1.8 – 120	fonofos (dyfonate)	0.019 - 0.1	3.8 –120
atrazine	0.0094 - 0.052	1.8 – 120	heptachlor	0.00094 - 0.0052	0.46 – 24
azinphos methyl (guthion)	0.019 – 0.1	7.7 – 460	heptachlor epoxide	0.00094 - 0.01	0.46 – 24
α-BHC (alpha)	0.00094 - 0.0052	0.46 – 24	hexazinone	0.019 – 0.1	7.7 – 460
β-BHC (beta)	0.0019 - 0.01	0.46 – 24	imidacloprid	0.4 – 0.8	ND
δ-BHC (delta)	0.00094 - 0.0052	0.80 – 46	linuron	0.4 - 0.8	7.6 – 190
γ-BHC (gamma) (lindane)	0.00094 - 0.0052	0.46 – 24	malathion	0.028 - 0.16	5.7 – 240
bromacil	0.038 – 0.21	11 – 690	metalaxyl	0.057 – 0.31	ND
butylate	0.019 - 0.1	ND	methamidophos	ND	38 – 930
carbophenothion (trithion)	0.028- 0.031	1.1 – 92	methoxychlor	0.0038 – 0.042	1.9 – 180
chlordane	0.0094 – 0.1	5.7 – 460	metolachlor	0.047 – 0.26	19 – 690
chlorothalonil	0.019 - 0.021	0.80 – 92	metribuzin	0.019 – 0.1	7.7 – 460
chlorpyrifos ethyl	0.019 - 0.1	3.8 – 240	mevinphos	0.038 – 0.21	9.3 – 600
chlorpyrifos methyl	0.019 - 0.1	3.8 – 240	mirex	0.0019 - 0.01	0.80 – 46
cypermethrin	0.0047 - 0.052	ND	monocrotophos (azodrin)	ND	76 – 1900
DDD-p,p’	0.0019 - 0.01	0.80 – 46	naled	0.075 – 0.42	31 – 690
DDE-p,p’	0.0019 - 0.01	0.80 – 46	norflurazon	0.028 – 0.16	11 – 690
DDT-p,p’	0.0019 - 0.01	1.1 – 46	parathion ethyl	0.019 – 0.1	3.8 – 240
demeton	0.094 – 0.52	38 – 2300	parathion methyl	0.019 – 0.1	3.8 – 240
diazinon	0.019 - 0.1	3.8 – 120	PCB	0.019 – 0.1	8 – 690
dicofol (kelthane)	0.019 - 0.042	0.80 – 180	permethrin	0.047 - 0.021	ND
dieldrin	0.0019 - 0.0052	0.46 – 24	phorate	0.028 - 0.16	3.8 – 120
disulfoton	0.028 - 0.16	5.7 – 240	prometryn	0.019 - 0.1	3.0 – 240
diuron	0.4 - 0.8	7.6 – 190	simazine	0.019 - 0.1	1.9 – 120
α-endosulfan (alpha)	0.0019 - 0.01	0.46 – 24	toxaphene	0.071 – 0.31	29 – 1400
β-endosulfan (beta)	0.0019 - 0.01	0.46 – 24	trifluralin	0.0094 - 0.01	1.5 – 93
endosulfan sulfate	0.0019 - 0.01	0.80 – 46	zinc phosphide	0.5 - 2.0	ND

ND = not determined

Table 2. Summary of pesticide residues above the method detection limit found in water samples collected by SFWMD in December 1998.

DATE	SITE	FLOW	COMPOUND (µg/L)												Number of compounds detected at site	
			ametryn	atrazine	bromacil	diuron	alpha endosulfan	beta endosulfan	endosulfan sulfate	ethion	ethoprop	hexazinone	metribuzin	norflurazon	simazine	
12/7/98	S12C	yes	-	0.042 *I	-	-	-	-	-	-	-	-	-	-	-	1
	S31	no	-	0.029 I	-	-	-	-	-	-	-	-	-	-	-	1
	S9	yes	-	0.024 I	-	-	-	-	-	-	-	-	-	-	-	1
	G123	no	-	0.027 I	-	-	-	-	-	-	-	-	-	-	-	1
	S142	no	0.025 I	0.40	-	-	-	-	-	-	-	-	-	-	0.029 I	3
	S38B	no	0.010 I	1.8	-	-	-	-	-	-	-	-	-	-	-	2
12/8/98	S331	no	-	0.012 I	-	-	-	-	-	-	-	-	-	-	-	1
	S176	no	-	0.022 I	-	-	-	-	-	-	-	-	-	-	-	1
	S332	yes	-	0.015 I	-	-	-	-	-	-	-	-	-	-	-	1
	S177	no	-	0.018 I	-	-	-	-	-	-	-	-	-	-	-	1
	S178	no	-	0.041 I	-	-	0.0083 I	0.0045 I	0.066	-	-	-	-	-	-	4
	S18C	no	-	0.018 *I	-	-	-	-	-	-	-	-	-	-	-	1
12/9/98	S140	no	-	0.013 I	-	-	-	-	-	-	-	0.080 I	-	-	-	2
	S190	yes	-	0.012 *I	0.12 *I	-	-	-	-	-	-	-	-	0.096 *I	0.039 *I	4
	L3BRS	yes	-	0.046 I	0.10 I	-	-	-	-	-	-	-	-	0.062 I	0.12	4
	S8	yes	0.016 I	0.15	0.049 I	-	-	-	-	-	-	-	-	-	-	3
	S7	no	-	0.040 I	-	-	-	-	-	-	-	-	-	-	-	1
	S6	no	0.018 I	0.066	-	-	-	-	-	-	-	-	-	-	-	2
	S5A	no	0.083	0.38	-	-	-	-	-	-	-	0.039 I	-	-	0.060 I	4
12/14/98	S80	no	-	-	0.076 I	-	-	-	-	-	-	-	-	0.54	0.027 I	3
	C25S99	no	-	-	-	-	-	-	-	0.027 I	-	-	-	0.80	-	2
	S191	yes	-	0.014 I	-	-	-	-	-	-	-	-	0.071 I	-	0.047 I	3
	S78	no	-	0.92	0.25	-	-	-	-	-	0.039 I	-	-	0.19	-	4
	CR33.5T	yes	-	0.47	-	-	-	-	-	-	-	-	-	0.40	0.089 I	3
	S79	yes	0.013 I	0.78	-	-	-	-	-	-	0.032 I	-	-	0.49	0.052 I	5
12/15/98	S235	yes	0.064	0.18	-	-	-	-	-	-	-	-	-	-	-	2
	S4	no	0.16 *	0.49 *	-	-	-	-	-	-	0.020 *I	0.024 *I	-	-	-	4
	S3	no	0.031 I	0.43	-	-	-	-	-	-	-	-	-	-	0.055 I	3
	S2	no	0.058	0.40	-	-	-	-	-	-	-	-	-	-	0.070 I	3
	G94D	yes	-	0.35	-	1.2 A	-	-	0.0074 I	-	-	-	-	-	-	3
	ACME1DS	yes	-	0.82	-	0.64 I	-	-	0.0029 I	-	-	-	-	-	-	3
	C51SR7	yes	0.052	0.16	-	-	-	-	-	-	-	-	-	-	-	2
Total number of compound detections			11	30	5	2	1	1	3	1	3	3	1	7	10	

- denotes that the result is below the MDL * results are the average of duplicate sample I value reported is less than the minimum quantitation limit, and greater than or equal to the minimum detection limit

Table 3. Summary of pesticide residues above the method detection limit found in sediments samples collected by SFWMD in December 1998

DATE	SITE	COMPOUND (µg/Kg)					Number of compounds detected at site
		ametryn	beta endosulfan	DDD	DDE	DDT	
12/7/98	S31	-	-	-	12 I	-	1
12/8/98	S331	-	-	-	2.3 I	-	1
	S177	-	3.8	1.8 I	10	-	3
	S178	-	-	-	61	-	1
	S18C	-	-	-	2.3 *I	-	1
12/9/98	S7	15 I	-	-	-	-	1
	S5A	-	-	5.4	8.7	2.1 I	3
Total number of compound detections		1	1	2	6	1	

- denotes that the result is below the MDL * results are the average of duplicate sample I value reported is less than the minimum quantitation limit, and greater than or equal to the minimum detection limit

Table 4. Selected properties of pesticides found in the December 1998 sampling event.

common name	FDEP Surface Water Standards 62-302 (µg/L)	Florida Ground Water Guidance Conc. (µg/L)	LD_{50} acute rats oral (mg/Kg) (1)	EPA carcinogenic potential	Water Solubility (mg/L) (2, 3)	Koc (ml/g) (2, 3)	soil half-life (days) (2, 3)	SCS rating (2) LE	SA	SS	Bioconcentration Factor (BCF)
ametryn	-	63	1110	D	185	300	60	M	M	M	33
atrazine	-	3**	3080	C	33	100	60	L	M	L	86
bromacil	-	90	5200	C	700	32	60	L	M	M	15
DDD-p,p'	-	0.1	3,400	-	0.055	239,900	-	-	-	-	3,173
DDE-p,p'	-	0.1	880	-	0.065	243,220	-	-	-	-	2,887
DDT-p,p'	0.001	0.1	113	-	0.00335	140,000	-	-	-	-	15,377
diuron	-	14	3,400	D	42	480	90	M	M	L	75
alpha-endosulfan	0.056	0.35	70	-	0.53	12,400	50	XS	L	M	884
beta-endosulfan	-	0.35	70	-	0.28	-	-	-	-	-	1,267
endosulfan sulfate	-	0.3	-	-	0.117	-	-	-	-	-	2,073
ethion	-	3.5	208	-	1.1	8,900	150	S	L	M	586
ethoprop	-	-	62	-	750	70	25	L	S	M	15
hexazinone	-	231	1690	D	33000	54	90	L	M	M	2
metribuzin	-	175	2,200	D	1,220	41	30	L	S	M	11
norflurazon	-	280	9400	-	28	700	90	M	M	L	94
simazine	-	4**	>5000	C	6.2	130	60	L	M	M	221

SCS Ratings are pesticide loss due to leaching (LE), surface adsorption (SA) or surface solution (SS) and grouped as large (L), medium (M), small (S) or extra small (XS)
Bioconcentration Factor (BCF) calculated as BCF = 10^(2.791 - 0.564 log WS) (4)
B2: probable human carcinogen; C: possible human carcinogen; D: not classified; E: evidence of non-carcinogen for humans (5)
FDEP surface water standards (12/96) for Class III water except Class I in ( )
**primary standard

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Table 5. Toxicity of pesticides found in the December 1998 sampling event to selected freshwater aquatic invertebrates and fishes (ug/L).

common name	48 hr EC_{50} Water flea *Daphnia magna*		acute toxicity (*)	chronic toxicity (*)	96 hr LC_{50} Fathead Minnow (#) *Pimephales promelas*		acute toxicity	chronic toxicity	96 hr LC_{50} Bluegill *Lepomis macrochirus*		acute toxicity	chronic toxicity	96 hr LC_{50} Largemouth Bass *Micropterus salmoides*		acute toxicity	chronic toxicity	96 hr LC_{50} Rainbow Trout (#) *Oncorhynchus mykiss*		acute toxicity	chronic toxicity	96 hr LC_{50} Channel Catfish *Ictalurus punctatus*		acute toxicity	chronic toxicity
ametryn	28,000	(7)	9333	1400	-		-	-	4,100	(5)	1367	205	-		-	-	8,800	(5)	2933	440	-		-	-
atrazine	6900	(7)	2300	345	15,000	(7)	5000	750	16,000	(5)	5333	800	-		-	-	8,800	(5)	2933	440	7,600	(5)	2533	380
bromacil	-		-	-	-		-	-	127,000	(7)	42333	6350	-		-	-	36,000	(7)	12000	1800	-		-	-
DDD-p,p'	3,200	(9)	1,067	160	4,400	(1)	1,467	220	42	(1)	14	2.1	42	(1)	14	2.1	70	(1)	23.3	3.5	1,500	(1)	500	75
DDE-p,p'	-		-	-	-		-	-	240	(1)	80	12	-		-	-	32	(1)	10.7	1.6	-		-	-
DDT-p,p'	-		-	-	19	(6)	6.3	0.95	8	(6)	2.7	0.4	2	(6)	0.7	0.10	7	(6)	2.3	0.35	16	(6)	5.3	0.8
diuron	1,400	(7)	467	70	14,200	(7)	4,733	710	5,900	(5)	1,967	295	-		-	-	5,600	(5)	1,867	280	-		-	-
endosulfan	166	(7)	55	8	1	(1)	0.3	0.05	1	(1)	0.33	0.05	-		-	-	1	(1)	0.33	0.050	1	(1)	0.3	0.05
	-		-	-	-		-	-	2	(3)	0.67	0.10	-		-	-	3	(2)	1	0.15	1.5	(7)	0.5	0.08
	-		-	-	-		-	-	-		-	-	-		-	-	1	(3)	0.33	0.050	-		-	-
	-		-	-	-		-	-	-		-	-	-		-	-	0.3	(6)	0.10	0.015	-		-	-
ethion	0.06	(1)	0.02	0.003	720	(1)	240	36	210	(1)	70	11	173	(1)	58	9	500	(1)	167	25	7,600	(1)	2,533	380
	-		-	-	-		-	-	13	(3)	4.3	0.65	150	(4)	50	8	193	(3)	64	10	7,500	(4)	2,500	375
	-		-	-	-		-	-	22	(4)	7.3	1.1	-		-	-	560	(4)	187	28	-		-	-
ethoprop	93	(7)	31	4.7	-		-	-	-		-	-	-		-	-	13,800	(5)	4,600	690	-		-	-
hexazinone	151,600	(7)	50533	7580	274,000	(5)	91333	13700	100,000	(7)	33333	5000	-		-	-	180,000	(7)	60000	9000	-		-	-
metribuzin	4,200	(7)	1,400	210	-		-	-	80,000	(5)	26,667	4,000	-		-	-	64,000	(5)	21,333	3,200	1000,000	(7)	33,333	5,000
norflurazon	15,000	(7)	5000	750	-		-	-	16,300	(7)	5433	815	-		-	-	8,100	(7)	2700	405	>200,000	(5)	>67,000	>10,000
simazine	1,100	(7)	367	55	100,000	(7)	33333	5000	90,000	(5)	30000	4500	-		-	-	100,000	(7)	33333	5000	-		-	-

(*) Florida Administrative Code (FAC) 62-302.200, for compounds not specifically listed, acute and chronic toxicity standards are calculated as one-third and one-twentieth, respectively, of the amount lethal to 50% of the test organisms in 96 hours, where the 96 hour LC_{50} is the lowest value which has been determined for a species significant to the indigenous aquatic community.

(#) Species is not indigenous. Information is given for comparison purposes only.

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Figure 2. Endosulfan Concentration in Surface Water at S178

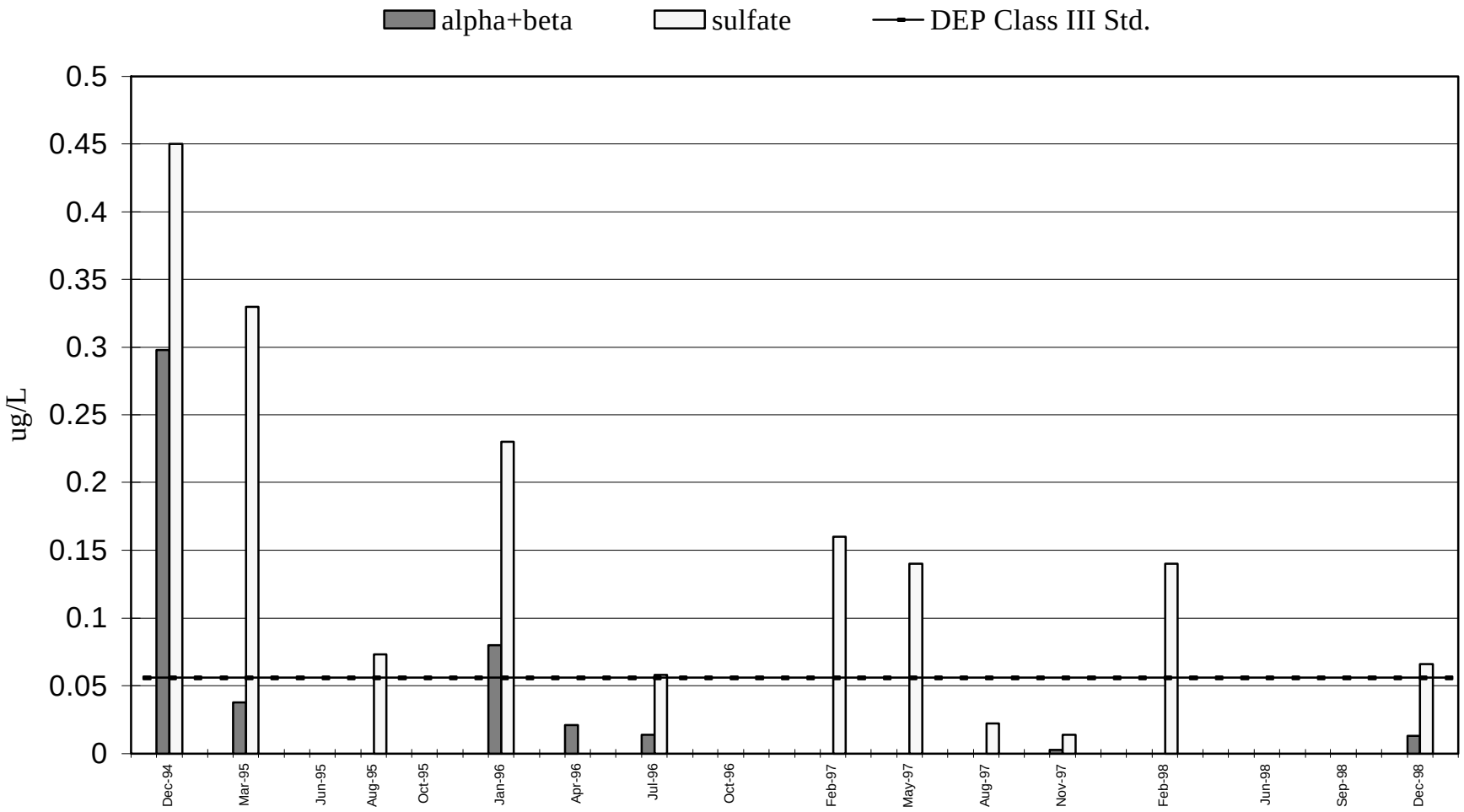

Figure 3. Ethion Concentration in Surface Water at S99